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Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड़ नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 397-0 (2003): Methods for Statistical Quality Control During Production, Part 0: Guidelines for Selection of Control Charts [MSD 3: Statistical Methods for Quality and Reliability]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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भारतीय मानक

उत्पादन के दौरान गुणता नियंत्रण की प्रणाली

भाग 0 नियंत्रण सारणी के चयन के लिए मार्गदर्शिका

(पहला पुनरीक्षण)

Indian Standard

METHODS FOR STATISTICAL QUALITY CONTROL DURING PRODUCTION

PART 0 GUIDELINES FOR SELECTION OF CONTROL CHARTS

(First Revision)

ICS 03.120.30

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard (Part 0) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Statistical Methods for Quality and Reliability Sectional Committee had been approved by the Management and Systems Division Council .

The control charts are extensively being used by the industry for controlling the quality during manufacturing. For this purpose, the Indian Standards describing various control charts to be used under different situations have been published as different parts of IS 397.

For wider application, a need was felt to provide the guidelines for selection of an appropriate control chart for a specific application. This standard has been brought out to fulfil that need and this standard has been made a part of this series. Apart from the field of application, the merits and demerits of each type of chart are discussed. The tabular presentation would enable the user to quickly select the relevant chart, to be used in a given situation.

This standard was originally issued in 1999. The revision of this standard has been under taken to incorporate many changes in Table 1 under different headings.

In addition to this Part 0, IS 397 has the following four parts:

(Part 1) : 2002   Control charts for variables (*second revision*)
(Part 2) : 2002   Control charts for attributes (*third revision*)
(Part 3) : 2002   Special control charts by variables (*first revision*)
(Part 4) : 2002   Special control charts by attributes (*first revision*)

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

Indian Standard

METHODS FOR STATISTICAL QUALITY CONTROL DURING PRODUCTION

PART 0 GUIDELINES FOR SELECTION OF CONTROL CHARTS

(First Revision)

1 SCOPE

This standard (Part 0) provides guidelines for selection and use of appropriate control chart(s) for controlling the processes during production. Merits and demerits of each type of control chart have also been discussed.

2 REFERENCES

The following standards contain provisions, which through reference in this text constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	Title
397	Methods for statistical quality control during production:
(Part 1) : 2002	Control charts for variables (*second revision*)
(Part 2) : 2002	Control charts for attributes (*third revision*)

IS No.	Title
(Part 3) : 2002	Special control charts by variables (*first revision*)
(Part 4) : 2002	Special control charts by attributes (*first revision*)
7920	Statistical vocabulary and symbols:
(Part 1) : 1994	Probability and general statistical terms (*second revision*)
(Part 2) : 1994	Statistical quality control (*second revision*)
14977 : 2001	Control charts based on inspection by gauging

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 7920 (Part 1) and IS 7920 (Part 2) shall apply.

4 TYPES OF CONTROL CHARTS AND THEIR APPLICABILITY

The guidance for choosing appropriate control charts for control of process during production is given in Table 1.

Table 1 Types of Control Charts and Their Applicability

(*Clause* 4)

Sl No. (1)	Type of Chart (2)	General Field of Application (3)	Merits (4)		Demerits (5)		Ref to Cl of Indian Standard (6)
Variable Type of Data							
i)	$\overline{X} - R$	Control of individual characteristic when sample results are available at small intervals and/or the product is not perfectly homogeneous	a)	Maximizes information from available data	a)	Difficult to understand, training becomes necessary	6.3.2.1 of IS 397 (Part 1)
			b)	Provides information on central value and variation for control	b)	Less precise for assessment of variation for large samples as Range may be affected by presence of extreme values.	
			c)	Samples of small size suffices			
			d)	Convenient for shop-floor operators			
ii)	$\overline{X} - s$	do	a)	Same as for $\overline{X} - R$ chart	a)	Difficult to understand, training becomes necessary	6.3.2.1 of IS 397 (Part 1)
			b)	More precise for assessment of variation	b)	Requires more calculations	
			c)	Applicable even for large samples			

Table 1 (*Continued*)

Sl No.	Type of Chart	General Field of Application	Merits		Demerits	Ref to Cl of Indian Standard
(1)	(2)	(3)	(4)		(5)	(6)
iii)	Median – R	Control of individual characteristic when sample results are available at small intervals and/or the product is not perfectly homogeneous	a)	Same as $\overline{X} - R$ chart b) Easy to adopt when sample size is odd and small c) More appropriate in certain situations for example non-normal distributions as median is not affected by extreme values	a) Inconvenient to use when sample size is large or even. b) Less efficient as compared to mean chart	6.3.2.2 of IS 397 (Part 1)
iv)	Mid range – R	do	a)	Same as $\overline{X} - R$ chart b) Calculation is simplified	Less efficient than mean chart	6.3.2.3 of IS 397 (Part 1)
v)	X (Individual)	Control of individual characteristic when sample results are available at longer intervals or product is homogeneous	a) Simple to operate b) Specification limits can be super imposed on control chart		Short-term variations not detectable	6.3.3 of IS 397 (Part 1)
vi)	Moving averages and moving range	Control of individual characteristic when sample results are available at small intervals and/or the product is not perfectly homogeneous	a) Need not wait for accumulation of samples b) Provides an early warning signal c) It is more efficient than $\overline{X} - R$ chart		a) Successive points are not independent b) Traditional interpretation of runs is not valid	6 of IS 397 (Part 1)
vii)	Extreme values	When sample is large in size (greater than six) and sequence of production is irrelevant	a) Extremely simple since no calculation is required b) One chart instead of two charts		Not very useful when the process is erratic	7 of IS 397 (Part 3)
viii)	Coefficient of variation	Relative variability in relation to mean is of concern	One chart instead of two		More calculations are involved	8 of IS 397 (Part 3)
ix)	Sloping control	Control of individual characteristics when the process level is changing systematically	a) It minimizes the frequency of process adjustments resulting in corresponding cost reduction b) Calculations are simplified		a) Useful only when process capability index is very high b) Less efficient than mean chart	5 of IS 397 (Part 3)
x)	Modified control	Control of individual characteristic when process capability index is high (preferably C_{pk} is more than 1.50)	May be used as adjustment chart if systematic trends or cyclic patterns exist		Not recommended when components are meant for assembly	10 of IS 397 (Part 1)
xi)	Group control	There must be several sub-group sources that approximately have same production rate and process capability	a) Involves less work in plotting the chart b) Compact presentation makes it easier to interpret c) It is easier to identify sub-groups running consistently high or low		Needs experience and skill in interpretation	4 of IS 397 (Part 3)
xii)	Cusum	Control of individual characteristic	Particularly useful when detection of small changes which go undetected in usual charts and are yet vital		Needs training and more calculations	9 of IS 397 (Part 3)

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Table 1 (*Continued*)

Sl No. (1)	Type of Chart (2)	General Field of Application (3)	Merits (4)	Demerits (5)	Ref to Cl of Indian Standard (6)
Attribute Type of Data					
xiii)	*np*	Control of overall fraction non-conforming items of a process	a) Data required are often already available from inspection records b) Easily understood c) Provides overall picture	a) Does not provide detailed information for control of individual characteristic b) Does not recognize degrees of defectiveness in units of product c) Requires fixed sample size from each sub-group	6.3.2 of IS 397 (Part 2)
xiv)	*p* (proportion) or *P* (percent)	Control of overall proportion/percent non-conforming items of a process	a) Same as for *np* chart b) This chart is used when sample size (*n*) varies.	a) Does not provide detailed information for control of individual characteristic b) Does not recognize degrees of defectiveness in units of product c) Control limits vary with the sample size, and therefore, these limits will not be straight lines d) Requires more calculations as compared to *np* chart	6.3.1 of IS 397 (Part 2)
xv)	Standardized '*p*'	Control of overall fraction non-conforming of a process	a) Control limits and standard line are fixed b) Interpretation is facilitated	Involves more calculations	6 of IS 397 (Part 4)
xvi)	*c* (number of non-conformities)	Control of overall number of non-conformities of a process	a) Index of non-conformities per unit is easily understandable b) Very simple and easy to understand	a) Does not provide detailed information for control of individual characteristics b) Not applicable when unequal number of items are being inspected from each sub-group	6.3.3 of IS 397 (Part 2)
xvii)	*u* (number of non-conformities per item)	Control of overall number of non-conformities per item of a process	Applicable in situations when sample size vary	Control limits depend on sample size and therefore, these limits will not be straight lines	6.3.4 of IS 397 (Part 2)
xviii)	Demerit score	Control of non-conformities with their criticality	a) In addition to advantages of *c* (or *u*-) chart, it takes into account the intensity, extent and seriousness of non-conformity b) Scoring system considers the extent and seriousness of non-conformities	a) Scoring system has to be worked out and its usages explained through a suitable training programme b) Involves more calculations	5 of IS 397 (Part 4)
xix)	Master control system	Control of overall fraction non-conforming of a process	a) Applicable in situations when sample size from each sub-group is different b) Provides immediate picture for any dominant variation for taking immediate necessary action c) Minimum number of *p* or *c* charts to be maintained d) Information can be used for audit and control e) Number of non-conformities with details of sources are recorded	a) Does not provide detailed information for control of individual characteristic b) Does not recognize degree of defectiveness in units of product c) Standard and limits vary with the sample size and therefore, not suitable when sample size varies (quantity inspected)	4 of IS 397 (Part 4)

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Table 1 (*Concluded*)

Sl No.	Type of Chart	General Field of Application	Merits	Demerits	Ref to Cl of Indian Standard
(1)	(2)	(3)	(4)	(5)	(6)
xx)	$C-a$, $c+a$ (Inspection by gauging)	Control of individual characteristics, when hitting the target is essential, as in assembly operations	a) Data on number of oversize and undersize items available b) Measurement of individual values is difficult, uneconomic or impossible but easy to know whether it is below or above a certain value X c) As substitute of $\overline{X} - R$ chart, it requires larger sample size but still reduces overall inspection load d) It is more efficient than p chart	Requires training and conviction that narrow gauging will not be harsh in application since artificial level of acceptance is created consistent with quality requirements	6 of IS 14977

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Statistical Methods for Quality and Reliability Sectional Committee, MSD 3

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University of Delhi, Delhi	PROF M. C. AGRAWAL
In personal capacity (*20/1, Krishna Nagar, Safdarjung Enclave, New Delhi 110029*)	SHRI D. R. SEN
In personal capacity (*B-109, Malviya Nagar, New Delhi 110017*)	PROF A. N. NANKANA
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Member Secretary
SHRI LALIT KUMAR MEHTA
Deputy Director (MSD), BIS

Basic Statistical Methods Subcommittee, MSD 3 : 1

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	SHRI G. W. DATEY (Alternate)
Powergrid Corporation of India Ltd, New Delhi	DR S. K. AGARWAL
Standardization, Testing and Quality Certification, New Delhi	SHRI S. K. KIMOTHI
TELCO, Pune	SHRI SHANTI SARUP
University College of Medical Sciences, Delhi	DR A. INDRAYAN
University of Delhi, Delhi	PROF M. C. AGRAWAL
In personal capacity (20/1, Krishna Nagar, Safdarjung Enclave, New Delhi 110029)	SHRI D. R. SEN
In personal capacity (B-109, Malviya Nagar, New Delhi 110017)	PROF A. N. NANKANA

Panel for 'Process Control', MSD 3:1/P-2

In personal capacity (B-109, Malviya Nagar, New Delhi 110017)	PROF A. N. NANKANA (Convener)
National Institution for Quality and Reliability, New Delhi	SHRI Y. K. BHAT
Powergrid Corporation of India Limited, New Delhi	DR S. K. AGARWAL
Standardization, Testing and Quality Certification, New Delhi	SHRI S. K. KIMOTHI
TELCO, Pune	SHRI SHANTI SARUP
In personal capacity (20/1, Krishna Nagar, Safdarjung Enclave, New Delhi 110029)	SHRI D. R. SEN

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BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002   Telegrams : Manaksanstha
Telephones : 2323 0131, 2323 33 75, 2323 9402   (Common to all offices)

Regional Offices :   Telephone

Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	{ 2323 7617 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700 054	{ 2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160 022	{ 60 3843 60 9285
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